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Health-related quality of life, depression and anxiety in thyroid cancer patients

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Abstract

Objectives: We examined the relationships among physical complaints, health-related quality of life (HRQL), anxiety and depression in differentiated thyroid cancer (DTC) patients under short-term hypothyroidism. *Methods*: We conducted a cross-sectional study in 136 patients hypothyroid on thyroid hormone withdrawal (THW) hospitalized for radioiodine administration. Patients were assessed using Short Form SF-36 (SF-36), Hospital Anxiety and Depression Scale (HADS), Profile of Mood States (POMS), Beck Depression Inventory (BDI), and physical complaints. *Results*: Compared to the German general population, hypothyroid patients had significantly impaired HRQL. Surprisingly, the prevalence of anxiety (62.5%), but not depression (17.9%) was much higher in hypothyroid DTC patients than in the general population. In multivariate analysis, depression and age were independently associated with the physical health score ($R^2 = 0.21$), but only psychological variables (depression, mood disturbance, and anxiety) were associated with the mental health score ($R^2 = 0.43$), on the SF-36 HRQL instrument. *Conclusions*: HRQL is severely impaired in DTC patients under short-term hypothyroidism. As potential predictors of generic HRQL impairment, depression, anxiety, and mood disturbance could be used to preselect the patients most needing psychiatric care. The high frequency of anxiety should be considered in the aftercare of thyroid cancer patients.

Key words: Differentiated thyroid cancer, Hypothyroidism, Health-related quality of life, Anxiety, Depression

Introduction

In recent years, increasing attention has been paid to mental health among cancer patients [1, 2]. The concept of health-related quality of life (HRQL) covers the patient's perceptions of his or her physical, emotional, social, and cognitive functions and, importantly, disease symptoms and side effects of treatment. Measurement of HRQL has become better accepted as a way to collect more meaningful data about cancer patients' subjective experiences on cancer therapy [2]. At the same, depression and anxiety have become recognized as the most frequent emotional problems in cancer patients [3], with an important impact on HRQL [4].

At the time the present study was conducted, relatively little had been reported about HRQL, and, especially, depression and anxiety in patients with differentiated thyroid cancer (DTC) under short-term hypothyroidism. Hypothyroidism is accompanied by a high prevalence of physical complaints like fatigue, sleep disorders, dry skin,

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and cold intolerance affecting profoundly physical well-being and functioning, resulting in poor HRQL [5]. Furthermore, neuropsychological and psychiatric disturbances in hypothyroidism such as psychomotoric slowing, depression, or anxiety have been described in previous studies [6, 7].

Published studies on DTC patients either had small patient populations or were qualitative [8–11] or did not focus or report in depth on these issues [7, 12]. DTC patients are considered to have a good prognosis (10- and 20-year survival rates as high as 90% and 60%, respectively) [13]. However, due to the relatively indolent course of the tumor, up to 20% of patients develop local or locoregional recurrence and up to 13%, distant metastases, as long as decades after the initial diagnosis [14]. Therefore patients require long-term monitoring for persistent or recurrent disease. The two main monitoring procedures have been radioiodine whole-body scan (WBS) and serum thyroglobulin (Tg) testing, both of which depend on elevated serum thyroid-stimulating hormone (TSH) concentrations (> 30 mU/L) to optimize sensitivity. Most DTC patients have been rendered athyroid during their initial treatment. To attain a euthyroid state and suppress TSH to barely detectable levels that are less likely to stimulate tumor growth, they then are placed on supraphysiologic doses of thyroid hormone. Thus traditionally, periodic thyroid hormone withdrawal, usually lasting at least 4 weeks and causing symptomatic hypothyroidism, has been necessary to achieve TSH elevation in most DTC patients. Recently, recombinant human TSH (rhTSH) was developed to allow sensitive WBS and Tg testing while patients remain euthyroid on thyroid hormone replacement [8, 12].

The availability of rhTSH for use in thyroid cancer surveillance is likely to improve quality of life of patients with DTC. Furthermore, the availability of rhTSH may promote patients compliance concerning the required diagnostic procedures [15]. On the other hand, even in countries with highly developed health care systems the financial resources are running short. The question remains if the use of a relatively expensive adjuvant (costs about $1000) is justified in relation to the potential side effects caused by short-term hypothyroidism. Haugen et al. [12] demonstrated a significant deterioration in the physical and emotional components of the SF-36 tools used to assess quality of life in patients during the hypothyroid phase of the study as compared to the rhTSH phase. The signs and symptoms of hypothyroidism, including cold intolerance, weight gain, constipation, and slowness in movements all contribute to the substantial impact on the patient's ability to perform optimally and may lead to lost time at work. The concurrent symptoms of hypothyroidism result in a substantial disruption of the patients' lives and ability to work.

We conducted the present study with three objectives: (1) to characterize in depth physical complaints, HRQL, depression and anxiety in a large group of DTC patients hypothyroid on thyroid hormone withdrawal; (2) to test correlations between mental and physical HRQL summary scores and between these scores and various demographic, physical and psychological variables; and (3) to identify factors influencing HRQL in this population.

Material and methods

Study design and patients

In the cross-sectional study, we asked all thyroid cancer patients hospitalized at our center for diagnostic or therapeutic radioiodine administration under thyroid hormone withdrawal and hence, hypothyroid conditions at any time from February to December 2001 to complete instruments rating their physical, HRQL, and psychological status. On the first day of hospitalization, before medical assessments, patients also completed 5 German-language instruments to rate their hypothyroid symptoms, HRQL and psychological status.

Of 160 eligible patients, 141 (88%) agreed to participate in the cross-sectional study, 4 (3%) refused, and 15 (9%) were excluded because of insufficient German language proficiency to understand the study instruments. Data from 5 (4%) of the 141 participants had to be discarded because of very incomplete responses. Thus, 136 patients (85% of eligible patients) ultimately were included in the current study. All patients provided written informed consent and the local ethics committee approved the protocol.

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Clinical procedures

Our thyroidectomized DTC patients normally receive levothyroxine in a dose (~2.5 μg/kg of body weight). In patients undergoing thyroid hormone withdrawal, levothyroxine treatment was discontinued 4 weeks before radioiodine administration (6 patients took liothyronine, 20 μg BID, for the first 2 weeks of levothyroxine withdrawal).

According to German radioprotection law, patients receiving radioiodine must be hospitalized for at least 48 hours. On day 1 of hospitalization, clinical examination, neck ultrasonography, and measurement of TSH, free thyroid hormones, Tg and routine clinical chemistry were performed, and radioiodine was given orally as a capsule in the early afternoon. WBS was performed 3 to 10 days after radioiodine administration.

Study instruments

Health survey short form-36 (SF-36)

The *Medical Outcome Study Short-Form 36 (SF-36)* [16] was used to assess generic HRQL. This generic instrument covers aspects of physical, psychological, and social functioning [17]. It measures 4 domains in the area of physical health: physical functioning, role limitation physical, bodily pain and general health perception and 4 domains in the area of mental health: emotional role limitation, vitality, mental health and social functioning. Two summary scores are computed to reflect the physical or mental domains of HRQL: physical component summary (PCS) and mental component summary (MCS). We compared the SF-36 scores of the present study with those of a large (N = 2911) German general population group [18].

The Hospital Anxiety and Depression Scale (HADS)

To assess depression and anxiety, the study used the HADS, a 14-item questionnaire that is particularly suitable for somatically ill patients [19]. As recommended by Zigmond and Snaith [19], we grouped our patients according to their subscale scores as non-cases (0–7 score), as borderline cases (8–10 score) or as definite cases (11–21 score).

Beck depression inventory (BDI)

Also used to assess depression, specifically, its cognitive and physical symptoms, was this 21-item questionnaire [20], in which each item is scored on a 4-point scale, with higher scores denoting greater severity. Total scores on the instrument of ≤ 10 reflect normal mood variation and of ≥ 11, increasing degrees of clinical depression.

Profile of mood states (POMS)

To assess overall psychological distress and specific mood states, the study used this 65-item scale [21] that asks patients to describe their mood over the previous week with adjectives rated from 0 (not at all) to 4 (extremely). The instrument contains six subscales originally derived from factor analytic studies: fatigue-inertia, depression-dejection, vigor-activity, confusion-bewilderment, tension-anxiety, and anger-hostility. To capture the patient's overall psychological status on the POMS, we used the total mood disturbance (TMD) score, which is the sum of the five negative mood state subscales, minus the vigor subscale. The validity and reliability of the POMS have been documented extensively, especially in cancer [22].

Physical Complaints Scale

To assess hypothyroid physical complaints, the study used an instrument based on the scales of Billewicz et al. [23] and Zulewski et al. [5], excluding two items (decrease in pulse rate, slowing of ankle jerk) that could not be efficiently self-rated.

Statistical analyses

Data were analyzed using SPSS for Windows, version 11.0. For between-group comparisons, continuous variables were evaluated using the Student *T*-test. Correlations between findings were tested by calculation of Pearson's correlation coefficient. To evaluate predictors of HRQL, multiple stepwise regression analyses were conducted using the PCS and MCS as dependent variables. Demographic (age, gender, education level, relationship status), physical (TSH value), and psychological factors (HADS-D, HADS-A scores, TMD) were tested as independent variables. Differences were considered statistically significant when the *p*-value was <0.05. All tests were formulated two-tailed.

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Results

Patient characteristics

Table 1 shows the demographic, clinical, and laboratory data. The total sample consisted of 136 DTC patients, 39 (28.7%) men and 97 (71.3%) women ($\chi^2 = 24.7$, $p \leq 0.001$), who ranged in age from 17 to 80 years. The mean age of all participants was 52.2 years (SD 16.4). In terms of marital status, 116 (85.3%) patients were married or had an other partnership, 20 (14.7%) were living alone at the time of study participation. The most common thyroid cancer diagnoses were papillary carcinoma (65.4%) and follicular carcinoma (22.7%).

In addition, all had been thyroidectomized for DTC before study entry. Their mean serum TSH concentration on day 1 of hospitalization was 67 mU/L (range: 17–192 mU/L). At that time, all patients under thyroid hormone withdrawal were biochemically hypothyroid (free T4, free T3 or both below normal range). The mean time since diagnosis of thyroid cancer was 14.4 (SD 30.6) months.

Table 1. Patient characteristics

	All patients (N = 136)
Age	
Years: Mean (SD)	52.2 (16.4)
Gender	
Female	97 (72%)
Education	
No qualification	6 (5%)
≤ 9 years	56 (41%)
10–11 years	44 (32%)
12–13 years	9 (7%)
University degree	17 (13%)
Unknown	4 (3%)
Relationship status	
Marital/other partnership	116 (85%)
Living alone	20 (15%)
Employment status	
Full time/part time	72 (53%)
Unemployed	7 (5%)
Retired	9 (6%)
Homemaker	48 (35%)
Histology	
Papillary carcinoma	89 (65%)
Follicular carcinoma	35 (26%)
Hürthle cell carcinoma	10 (8%)
Insular carcinoma	2 (2%)
Time from diagnosis (months)	14.4 ± 30.6

Hypothyroid symptoms

Most patients in the present study reported symptomatic hypothyroidism (Table 2). Even the least common complaints were reported by just under a quarter of patients, while the most frequent symptoms were reported by more than 60%. Physical complaints were similar in both gender. Differences in physical complaint prevalence between men and women were statistically significant only with respect to cold skin ($\chi^2 = 5.1$, $p \leq 0.023$) and trended towards significance in cold intolerance ($\chi^2 = 3.1$, $p \leq 0.075$).

Health related quality of life: DTC patients versus German reference population

Mean values for all domains of SF-36 scales for the two groups are depicted in Table 3. In all domains of SF-36 hypothyroid DTC patients reported significantly reduced HRQL compared to the German reference group. In summary, DTC patients scored significantly lower for physical health (PCS) ($p \leq 0.001$) and mental health (MCS) ($p \leq 0.001$) in comparison to the German reference population.

Psychological distress: Depression, anxiety, mood disturbance

In the present study, mean ± SD depression scores were in the normal or non-clinically relevant range: 4.3 ± 3.5 on the HADS-Depression and 8.5 ± 6.9 on the Beck Depression Index. According to the cut-off criteria of the HADS-D, 12 patients (9%) were identified as borderline depression cases and another 11 (8%) as definite depression cases, for a probable prevalence of clinical depression of 17%.

In contrast, anxiety scores for the overall study population exceeded the borderline levels (mean ± SD HADS-A score of 8.6 ± 2.8). Fifty patients (37%) were identified as borderline anxiety cases and 35 patients (26%) as definite anxiety cases on the HADS-A, for an overall probable prevalence of anxiety of 63%.

In total, 86 patients (63%) suffered from psychological distress documented by the HADS-D, the HADS-A, or both. However, the mean ± SD

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Table 2. Physical complaints in thyroid cancer patients by gender

Physical complaints	All patients (N = 136)%	Men (n = 39)%	Women (n = 97)%	χ^2	p
Slow movements	62	58	63	0.25	0.612
Weight increase	61	60	62	0.08	0.771
Cold skin	61	46	67	5.1	0.023
Cold intolerance	56	44	62	3.1	0.075
Parasthesia	56	54	56	0.06	0.799
Periorbital puffiness	49	40	52	1.5	0.220
Hoarseness	50	46	36	0.97	0.323
Diminished sweating	38	45	36	0.97	0.323
Increased sweating	33	32	34	0.05	0.816
Coarse skin	28	22	30	0.86	0.353
Constipation	24	30	22	0.78	0.376
Hearing impairment	24	18	25	0.92	0.336

score, 29.9 ± 26.5 on the POMS TMD, which incorporates measurements of fatigue-inertia, confusion-bewilderment, anger-hostility and vigor-activity as well as depression and anxiety, was within normal range.

The correlations between the three used depression instruments were highly significant: HADS-Depression and BDI ($r = 0.70, p \leq 0.000$), HADS-Depression and TMD-Depression ($r = 0.57$, $p \leq 0.000$), BDI and TMD-Depression ($r = 0.65$, $p \leq 0.000$). In summary, the significant correlations' between the depression instruments ensure the validity of the results concerning prevalence of depression in hypothyroid DTC patients.

Correlations with SF-36-PCS and SF-36-MCS

We tested the correlation between the physical and mental health dimensions of HRQL, as reflected by the SF-36 PCS and MCS, respectively. We also tested the correlations between each of these 2 scores and scores on the other study instruments or selected demographic, physical or psychological variables. No significant correlations were found between the PCS and MCS ($r = 0.15$, $p \leq 0.20$), indicating that the subscales measure two independent dimensions of HRQL.

The PCS correlated significantly with worse scores on the HADS-D ($r = 0.45$, $p \leq 0.001$), the physical complaints survey ($r = -0.36$, $p \leq 0.001$) and the POMS TMD ($r = -0.32$, $p \leq 0.01$), and with age ($r = -0.23$, $p \leq 0.05$). The MCS correlated significantly in a negative direction with scores on the TMD subscale ($r = -0.66$, $p \leq 0.001$), the HADS-D ($r = -0.61$, $p \leq 0.001$), the HADS-A ($r = -0.51, p \leq 0.001$), and the physical complaints survey ($r = -0.48, p \leq 0.001$).

Of note, serum TSH concentration did not correlate with HRQL as measured by the PCS ($r = -0.02$, $p \leq 0.85$) or MCS ($r = -0.12$,

Table 3. SF-36 HRQL Scores: Cross-sectional and randomized studies and German reference population*

SF-36 Subscales and both components†	German reference population* (N = 2911)	DTC patients (N = 136)	T-value	Sig.
Physical Function	85.8 ± 22.1	64.0 ± 28.5	8.6	≤0.001
Role Physical	83.7 ± 31.7	42.0 ± 39.5	11.8	≤0.001
Bodily Pain	79.0 ± 27.3	72.9 ± 28.8	2.4	≤0.017
General Health	68.1 ± 20.1	59.1 ± 20.2	4.9	≤0.001
Physical Component Scale	50.2 ± 10.2	44.3 ± 9.5	6.3	≤0.001
Vitality	63.3 ± 18.4	41.6 ± 22.7	10.8	≤0.001
Social Functioning	88.7 ± 18.4	60.3 ± 24.9	12.8	≤0.001
Role Emotional	90.6 ± 25.6	50.0 ± 44.5	10.2	≤0.001
Mental Health	73.9 ± 16.3	61.3 ± 20.5	6.9	≤0.001
Mental Component Scale	51.5 ± 8.1	40.8 ± 10.2	10.8	≤0.001

HRQL, health-related quality of life; SF-36, Short Form-36 of the Medical Outcomes Survey.
*As reported in Bullinger and Kirschberger [17].
†On a scale of 0, worst and 100, best.

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$p \leq 0.30$), or with the physical complaint score ($r = 0.11$, $p \leq 0.34$).

We divided the patients in three independent groups by time since thyroid cancer diagnosis: Group 1, first radioiodine therapy (n = 47): 07–1.9 months; Group 2, second iodine therapy (n = 27): 4.5–6.9 months; Group 3, radioiodine diagnostic, about one year after final radioiodine therapy (n = 28): 16–18.8 months. There were no significant differences among the groups with regard depression, anxiety, mood disturbance and HRQL (data not shown).

Predictors of health related quality of life

We conducted multivariate analyses to identify demographic, physical and psychological variables with a significant independent impact on HRQL (Table 4). Depression and age were independently associated with the physical health score ($R^2 = 0.21$), but only psychological variables (depression, mood disturbance, and anxiety) were associated with the mental health score ($R^2 = 0.43$), on the SF-36 HRQL instrument.

Discussion

This is the first study to assess quantitatively and in depth via numerous standardized self-rating instruments, physical complaints, HRQL, depression, anxiety, and their interrelationships in a large sample of DTC patients undergoing short-term hypothyroidism. The study group was representative of thyroid cancer patients with regard to distribution of age, gender, and histological subtypes [24, 25].

HRQL was considerably reduced both in physical and psychosocial dimensions in thyroid cancer patients undergoing short-term hypothyroidism, relative to a healthy reference population. Our observations dovetail with those of 2 studies examining HRQL in the thyroid cancer population. One recent Spanish study (n = 36) showed that when hypothyroid, DTC patients had lower HRQL scores than healthy controls. However, when euthyroid, the same individuals had similar HRQL scores to those of the healthy controls, except on the general health functional scale, which was lower in the DTC patients [25]. In an Austrian study [26] of 150 consecutive DTC patients on levothyroxine, SF-36 HRQL functional scores were statistically similar between the DTC patients and sex- and age-matched healthy controls in all SF-36 functional areas except role emotional and vitality. Of interest, in the Austrian study, the SF-36 role physical, mental health, and social functioning scores also were significantly lower in the subgroup that had been diagnosed with DTC within 1 year of study entry, than in controls. This suggested an HRQL improvement in DTC patients with time since diagnosis. Hence, the length of this interval in a given study population could influence the study's HRQL findings. However, soubgroup analyses in our study population could not support these findings. One reason may be that the time since diagnosis of thyroid cancer with a mean of 14.4. months was to short.

Remarkably, our hypothyroid DTC patients suffered an even more pronounced decline in psychosocial HRQL than frequently is seen in patients with other cancers [27, 28]. For example, patients with non-thyroid cancer undergoing diagnostic or therapeutic procedures (e.g., laparoscopic staging for prostate cancer or lumpectomy for breast cancer) that presumably are similarly

Table 4. Predictors of SF-36 Physical and Mental Component Scale

Dependent variable	Covariates	Beta	*T*	*p*-value
Physical Component Scale (R^2:0.21)*	1. HADS-Depression	−0.40	−5.0	≤0.001
	2. Age	−0.20	−2.6	≤0.012
Mental Component Scale (R^2:0.43)*	1. HADS-Depression	−0.54	−7.4	≤0.001
	2. POMS-Total Mood Disturbance	−0.34	−4.5	≤0.001
	3. HADS-Anxiety	−0.18	−2.3	≤0.001

HADS, Hospital Anxiety and Depression Scale; POMS Profile of Mood States; SF-36, Short Form-36 of the Medical Outcomes Survey.
*Variance of the model.

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stressful as dxWBS or radioiodine treatment of DTC showed a similarly reduced physical HRQL, but a much better psychosocial HRQL compared to our sample [29].

Our assessment of depression and anxiety in the present study revealed two surprising findings. First, the severity of depressive symptoms in our hypothyroid patients was in the normal range for healthy reference populations [19, 21]. In addition, depression case prevalence as defined by HADS criteria was comparable the reference populations [28].

The lack of an abnormal degree of depression in the present study was confirmed by the mean POMS depression and Beck Depression Inventory scores, both of which fell into the "not clinically relevant" range. In contrast to our findings, others have found significantly [7, 25] and numerically [8] higher scores on the POMS depression subscale in DTC patients when they undergo short-term hypothyroidism than when they are euthyroid. The association between long-term thyroid hormone deficiency and clinical depression, even when the hypothyroidism is subclinical, is long-known and well-documented [7]: clinical depression occurs in $>40\%$ of chronically hypothyroid patients [30]. Taken with the results of earlier DTC studies [7, 8], our observations suggest that the association between short-term hypothyroidism and depression is less clear.

The second unexpected finding of the psychological testing in our study is the high prevalence of anxiety symptoms in DTC patients. While, in general, anxiety is even more frequent in oncological patients than is depression [1, 31], the high rate of HADS-Anxiety cases in our study group [4] is remarkable. We found a 37% prevalence of borderline cases in the present study. We noted that another 26% of our study population were definite HADS anxiety cases, while the analogous prevalences ranged from 6% in successfully treated patients with testicular cancer [32] to 19% in cancer patients in a radiotherapy unit [31].

Despite of the probable influence of the short-term hypothyroidism, environmental factors i.e., hospitalization under radiation protection and uncertainty over outcomes surrounding radioiodine diagnostic and treatment procedures may help explain the high rate of anxiety in our study. As Dow et al. [9] and Stajduhar et al. [11] point out, patients awaiting the results of the diagnostic procedures or kept in isolated conditions usually are extremely stressed; anxiety could be a correlative of this stress.

Chronical hypothyroidism, even in the mild form, is clearly associated with neurocognitive dysfunction including memory loss and depression [33]. Previous studies on hypothyroid subjects have indicated serious psychiatric symptoms affecting the patient's quality of life [8–10, 12]. In one recent German study [34] the authors examined the symptoms in thyroid patients with different functional states. A total of 254 patients were included. Euthyroid and hyperthyroid subjects did not differ significantly in their general health questionnaire score, nor did subclinical or subclinical hypothyroid subjects. In contrast, hypothyroid patients showed a significantly higher HRQL impairment. Hypothyroidism increases risk for mood deterioration by seven-fold. Thus, hypothyroidism represents a widely underestimated functional condition that may severly affect mental health.

Depression was the strongest predictor of impairment in both physical and mental dimensions of HRQL in hypothyroid DTC patients. The close association between depression and poor HRQL in cancer patients also has been pointed out by other kinds of cancer. Fossa and Dahl [32], studying survivors of testicular cancer and Skarstein et al. [4], studying survivors of various tumors found this mood state to be a stronger predictor than anxiety for reduced HRQL. Statistical associations may not always represent causal relationships. However, it may be speculated that depressed more than anxious patients, perceive their physical and mental health as impaired.

While depression was the main predictor of mental HRQL impairment, mood disturbance as measured by the POMS TMD and anxiety as measured by the HADS-A had significant independent additional effects. Demographic or somatic variables did not significantly affect mental HRQL. In contrast, besides depression, only older age had significant independent predictive value for physical HRQL impairment.

Our findings on predictors of HRQL impairment provide guidance for clinicians treating thyroid cancer patients, and investigators interested in HRQL impairment in this population. For example, depression and anxiety (evaluated with HADS), age, and POMS TMD score could be used

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to preselect patients at higher risk of HRQL impairment. Such patients could receive special psychiatric care. By contrast with thyroid hormone deficiency, TSH values showed no significant impact on HRQL, or for that matter, on depression, anxiety, mood disturbance or physical symptoms, in our hypothyroid DTC patients. A similar absence of correlation between TSH concentration and depression or bodily complaints has been observed by other authors in patients with long- as well as short-term hypothyroidism [5, 8]. In part, this lack of correlation could be due to the pronounced variations in TSH secretion: in the course of its circadian rhythm, peak and nadir concentrations differ by approximately 50% [35]. On the other hand, all blood samples were drawn between 9 and 11 hour a.m., and in a recent study it has been shown that diurnal rhythmicity of TSH secretion was abolished in a cohort of patients with short-term severe primary hypothyroidism [36].

In summary, our study showed that HRQL was distinctly reduced in DTC patients undergoing thyroid hormone withdrawal to prepare for follow-up diagnostic or therapeutic procedures. These results indicate that the detection of recurrences of DTC by WBS should be routinely based on the administration of rhTSH for the stimulation of thyroid remnants, instead of using withdrawal of thyroid hormone replacement therapy [7, 12]. Anxiety was considerably more frequent in DTC patients than in the general population and other cancer patient samples. Nevertheless, depression was the strongest independent predictor of HRQL impairment in hypothyroid DTC patients. It is notable that the findings of the current study were in a sample of patients who were hospitalized under radiation protection. Further research is required to complete our knowledge about the entirety of the factors that lead to poor HRQL in this population.

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